

ANALYSIS OF FANSTEEL INC. RADIOLOGICAL DATA

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## ANALYSIS OF FANSTEEL INC. RADIOLOGICAL SAMPLE DATA

This study is divided into three sections: analysis of raw data, occupational radiological hazards and environmental hazards. A list of recommendations concludes the report.

### SUMMARY OF RADIOLOGICAL DATA

Data reviewed consisted of gross beta, gross alpha, gamma spectroscopy and alpha spectroscopy on soil and water samples. Direct beta-gamma radiation readings were taken in the yard area of the site. Based on the sampling and analyses which were conducted, a degree of uncertainty exists in regard to the assessment of the radiological hazards at the site. The information provided does allow for preliminary evaluations which can be used as the basis for future actions. Based on a review of preliminary radiological data, it appears that the occupational radiation hazards are low to moderate. It is more difficult to assess the hazard to the environment due to the limited scope of sampling. It is advised that a more thorough sampling program be initiated to identify the quantities and location of radioactive materials buried at the site and the potential for ground water contamination from these sources. Liquid effluent releases, although exceeding NPDES guidelines, do not appear to have a significant contribution to environmental radioactivity.

### Soil Samples

The soil samples show statistically significant activity of Uranium-238, U-235, Thorium-232 and their daughter products above background. The levels of contamination associated with samples #26 and #27 (enclosure 3) are of particular concern. Assuming that the soil samples were collected in areas having the highest direct radiation levels, samples #26 and #27 represent the highest surface contamination levels on the site. Direct radiation readings are useful for locating hot spots of beta-gamma emitting material. However, direct radiation readings will be influenced by surface contamination as well as below surface depositions of radioactive material. Consequently, the level of activity in the analyzed sample may not be representative of the actual radiological hazard or the general contamination of soil surfaces. This would be especially true of the landfill area.

### Water Samples

The french drain sample contains statistically significant activities of U-238, U-235, Uranium daughters and Potassium-40. Liquid waste collected from the french drain system is processed and returned to lagoon 3. Uranium and its daughter products appear to be removed by processing. The remaining beta activity in the outfall appears to be from K-40. The surface water sample taken at the SE corner of the landfill indicates positive beta activity, however the source of the beta activity could not be identified from the data provided. The remaining well water samples approximate background levels.

There appear to be inconsistencies between gross beta and gamma spectroscopy analyses. Potassium-40 should contribute to the gross beta activity in an equal proportion to the activity as measured by gamma spectroscopy. Data indicates K-40 activity two times the gross beta activity for sample stations #21 and one of the samples taken from station #7. Although K-40 was statistically significant in only one of two samples taken from station #7, the gross beta activity for station #7 remained the same. These results create uncertainties with the assumption that K-40 is the major contributor to beta activity.

The french drain system may be draining the local monitoring wells, thereby questioning the validity of well samples for measuring ground water contamination. Data indicates that Uranium and K-40 are leaching into the french drain system. This data suggests potential low level groundwater contamination which should be confirmed through a more extensive sampling program.

### Direct Radiation

The general area radiation readings indicate a range of 100 to 1000 times natural background levels. However, in terms of radiation work areas, these levels are low. Enclosures 10 and 11 describe the general area radiation levels as less than 0.03 mR/hr with higher levels ranging from 1.2 mR/hr to 250 mR/hr. The higher radiation levels appear to be from mill tailing contamination on soil surfaces or buried in landfill. (The radiation survey data in enclosure 10 does not distinguish between gamma or beta radiations. The units of roentgen (R) are used to denote gamma radiation levels. The term Rads is typically used to denote beta radiation dose). This type of survey does not fully evaluate the hazard from materials buried in the ground because of shielding effects.

## OCCUPATIONAL RADIATION HAZARD

The occupational radiation hazards, based on direct radiation levels and projected airborne concentrations, are low to moderate. Assuming standard radiological work practices are employed, the measured levels of radiation do not represent a significant hazard for external radiation. The soil sample analysis shows a high gross beta activity, therefore, the reading of 250 mR/hr most likely includes a large beta component. Based on the assumption that 0.03 mR/hr is the general area exposure rate from penetrating radiation (gamma), a worker is likely to receive a dose of 1.2 mrem/week or approximately 16 mrem per quarter. This dose is within the NRC guidelines of 1250 mrem per quarter for whole body penetrating exposures. According to 10 CFR 20.202 "Personnel Monitoring", workers are not required to wear personnel radiation monitoring devices unless they are likely to exceed 25% of the applicable limit. In this case, 312 mrem per quarter. It is reasonable to assume that a few workers may be exposed to higher levels of radiation and require personnel monitoring. Should the majority of radiation be non-penetrating (beta radiation), the skin would be the tissue which requires monitoring. NRC exposure guidelines for the skin are less restrictive than those listed above. The need for monitoring would to be assessed based on projected doses from beta radiation.

Inhalation and ingestion pathways exist from airborne radioactivity when soils containing tailing are disturbed. Airborne radioactivity could also be a hazard when preparing samples for analysis. The level of Radon and Radon daughters may cause a moderate health hazard due to inhalation and alpha irradiation of the pulmonary region of the lung.

## ENVIRONMENTAL HAZARDS

The outfall contains less than 0.1 PCi/L Ra-226 and Ra-228. Total Radium activity released is well within EPA drinking water standards of 5 PCi/L. Based on analyzed samples, the beta-gamma dose equivalent to an off-site individual from liquids released and ground water contamination appears to be below drinking water standards.

The primary environmental hazard is the potential for radioactive material migrating through soils into local aquifers. Radioactive material transport may be further amplified due to the presence of organic and inorganic compounds.

It is indicated that the french drain system may be draining the monitoring wells. If this is the case, the water samples obtained from the wells may not be indicative of the actual conditions. Additional information is needed to assess the potential for the contamination of the Arkansas River and local aquifers.

The concentration of radionuclides found in the monitoring well samples is not an immediate concern. The more significant concern is the possibility of leaching or breakthrough in the soils where radioactive material has been accumulating over the history of the facility. Direct radiation readings taken in and around the plant suggest that material may be buried in shallow trenches at several locations within the site boundary. This is most apparent at soil sampling station #26 where a series of radiation readings indicate higher than background levels of radiation.

The potential for surface deposited tailings to move through the environment is moderate and warrants consideration. If tailings are buried in shallow trenches or the landfill, details should be obtained as to contents and total activity.

To identify the applicable EPA and NRC standards, it is necessary to accurately determine the origin of the radioactive material. Regulation on allowable concentration released to the environment is based on how material is defined, e.g., depleted uranium, natural uranium, or Technologically Enhanced Natural Radiation (TENR). The activity of effluents released through the outfall is well within the NRC limits for gross beta (3000 PCi/L) and alpha (30 PCi/L). The NPDES permitted discharge limit for gross beta activity is 50 PCi/L and 15 PCi/L for alpha. It appears that effluents released through the outfall exceed NPDES permitted discharge for gross beta, but are within NRC standards. Since outfall data suggests the major contribution to beta activity is natural occurring K-40, then EPA guidance on TENR may be applicable. Independent of the applicable standards the risk to environment from liquid discharges appears to be minimal.

## RECOMMENDATIONS

- 1) Activity released to the outfall should be monitored and sampled on a routine basis to assure that concentrations of Uranium and Uranium daughters are within applicable standards.
- 2) Perform additional studies to determine the total activity and location of radioactive materials buried on-site.
- 3) Resolve the source of beta activity in the outfall. Perform additional analysis of outfall samples to determine that K-40 is the major source of beta activity.
- 4) Site hydrology should be investigated to determine if the existing well sampling points are representative.
- 5) Additional surveys should be performed under the direction of a health physicist.
- 6) The beta-gamma ratio must be better defined to evaluate the radiation hazard at the site.
- 7) The bases for NPDES discharge limits should be evaluated.